Identification, Characterization, and Evaluation Criteria for Systems Engineering Agile Enablers

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14. ABSTRACT

The purpose of the SE Agile Enablers project is to identify, describe, and evaluate possible methods, practices or tools (enablers) that could improve the ability of systems engineering to adapt to changing development environments. In order to efficiently make use of scarce research resources, RT-124 has established a triage process for identifying and then rapidly evaluating the probability of effectiveness of candidate enablers as they are identified. In the SE community, it is important for systems to be agile and rapidly and effectively adapt to sudden changes in the environment. Process agility provides systems engineers with the methods, processes and tools necessary to operate more effectively in development environments driven by change. The ability to rapidly adapt is necessary while working with an increasing rate of technology advancement, an increasing need for interoperability between legacy and new capabilities, evolving requirements throughout the development lifecycle, and the changing economic and political factors that undergird and enable system development. The ultimate result of the process is an evaluation white paper identifying likelihood of efficacy, areas for research, and transition recommendations. After each execution of the process, a reflection activity will be held to identify strengths and weaknesses of the process and to identify and make appropriate improvements.

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INTRODUCTION

In the SE community, it is important for systems to be agile and rapidly and effectively adapt to sudden changes in the environment. Agility in SE is found in two general areas – process and product. Process agility provides systems engineers with the methods, processes and tools necessary to operate more effectively in development environments driven by change. The ability to rapidly adapt is necessary while working with an increasing rate of technology advancement, an increasing need for interoperability between legacy and new capabilities, evolving requirements throughout the development lifecycle, and the changing economic and political factors that undergird and enable system development. Perhaps one of the most important concepts in Agile SE is the reconciliation and integration of systems and software engineering activities. If software development processes are to operate seamlessly with SE processes, SE processes must borrow notions of agility and flexibility found in software engineering.

The purpose of RT-124 is to identify, describe, and evaluate possible methods, practices or tools (enablers) that could improve the ability of systems engineering to adapt to changing development environments. In order to efficiently make use of scarce research resources, RT-124 has established a triage process for identifying and then rapidly evaluating the probability of effectiveness of candidate enablers as they are identified. The ultimate result of the process is an evaluation white paper supporting one of three decisions:

1. not likely to be effective,
2. possibly suitable but more research is needed, or
3. definitely suitable and expedited transition is recommended.

This paper describes the process and its products. After each execution of the process, a reflection activity will be held to identify strengths and weaknesses of the process and to identify and make appropriate improvements.

SELECTION AND EVALUATION PROCESS OVERVIEW

The overall process, as illustrated in Figure 1, leverages nearly a decade of research into practice description, evaluation and dissemination represented by the DoD Acquisition Best Practices Clearinghouse (BPCh)..1 [1, 2, 3] The process itself can operate concurrently for a number of enablers, and the actual cadence can be adjusted by the number of enablers under consideration and the number and availability of evaluators.

IDENTIFICATION

Enablers can be found in many environments, disciplines, and activities. Real value can be achieved when a process used in one discipline can be adapted quickly to provide value in a different discipline. RT-124 attempts to identify enablers by monitoring the agile, lean, and adaptive research and practice ecosystems. Generally, the most efficient way of tapping into the communities is via existing communities of practice. This can be achieved through monitoring communications in social media groups and websites (such as LinkedIn or Facebook groups associated with the Scaled Agile Framework, Lean Enterprise Institute, Agile Alliance, Lean Systems Society and Model-based Systems Engineering), reading conference proceedings, attending workshops, and participating in working groups (such as the INCOSE Agile Systems Engineering WG).

Identification, however needs to employ a set of common criteria so that obviously inappropriate enablers are not pursued. The identification criteria developed for RT-124 are based on earlier SERC work. [4, 5, 6]:

- Supports some aspect of agility or leanness (e.g. small batch size, incremental/iterative development, value to the customer)
- Is reasonably defined (there is a somewhat standard definition)
- Aligns with at least one of the SEBOK systems engineering primary discipline areas
- Sufficient information exists to characterize it

[1] Operated by DAU, the BPCh was a web-enabled best practice repository and selection tool residing within the DAU knowledge management system and associated with DAU's acquisition communities of practice. The BPCh operated through 2010.

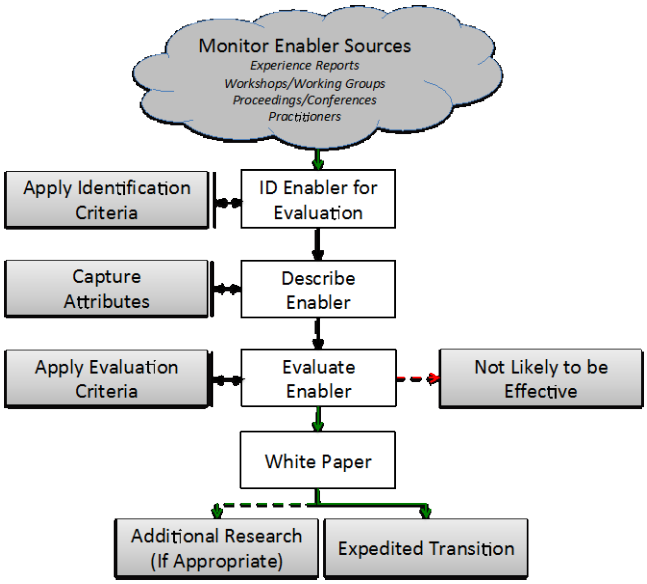

Figure 1: Overall Process

CHARACTERIZATION AND EVALUATION

Characterization consists of researching the identified enabler, gathering any evidence about its use and the results, if possible interviewing organizations that have applied it, and ideally (but rarely), finding any empirical studies regarding it.

To provide for a common language (ontology) and to enable continuous and consistent assimilation of information over time, it is appropriate to establish attributes to describe each enabler. The attributes are organized to support the evaluation criteria. Characterization attributes and their assessment scale are shown in Table 1. The attributes are intentionally broad to support a fairly rapid assessment of potential. The evaluation criteria are shown in Table 2.

Evaluation activities are centered around a single researcher identifying evidence from various sources, discussing the enabler with experts in its creation or use as well as with system engineering practitioners and managers. This information is then reflected in the attributes. Information from the attribute evaluation is provided to the research team, including a statistically based score for each criterion. This score is considered, but is not the only input to the decision making process. In general, the score for impact and relevance take precedence, since research can usually mitigate weaknesses in maturity and adoptability. However, lower scores indicate that the team should be very clear about the relationship between the possible benefit and the cost of proceeding.

If the researcher and the team believe that the enabler is simply not suitable, or that while it may show promise, the expense or extent of additional research does not seem to match the benefit, the enabler is discarded and the information filed as notes. If the team believes there is sufficient merit to do additional research, or if there is an indication that the enabler is already applicable, a white paper is generated and delivered to the sponsor.

Table 1: Enabler Attributes

Attribute	Description
Agile/Adaptive Impact Attributes *Evaluation Scale:* *Unknown - Not determinable at this time (score: <null>)* *None - Currently cannot support this attribute (score: -1)* *Partial Support - Does not negate this attribute (score: 0)* *Explicit Support - Designed to support this attribute (score: +1)*	
Batch Size	Limiting or supporting smaller batch sizes for SE activities
Iteration	Supporting iterative development capability
SE Activity Value	Determining the value of SE activities to support better SE efficiency and effectiveness
Customer Value	Accelerating the delivery of value to the customer
Work In Progress	Visibility of existing WIP or limiting WIP to increase flow and protect scarce resources
Scheduling	Flexibility to handle multiple priority tasks without unnecessary perturbation of engineering flow
Requirement Evolution	Changing/emergent requirements and the ability to evolve systems over time
Discipline integration	Better/faster/more effective communication and more rapid integration between various disciplines as changes occur
Artifacts	Development of fewer, higher-value artifacts that are easier to maintain congruent
Stakeholder Management	Effective and adaptive balancing of stakeholder needs
Relevance Attributes *Evaluation Scale:* *Unknown - Not determinable at this time (score: <null>)* *None – Currently cannot support this attribute (score: -1)* *Partial Support - Does not negate this attribute (score: 0)* *Explicit Support - Designed to support the attribute (score: +1)*	
Scalability	Can apply to all types of systems from simple to ultra-large SoSs with deep supplier chains and multiple concurrent and interacting initiatives.
Criticality	Can apply where there are stringent safety, security, or mission-critical requirements
Adaptability	Can adapt or extend to apply to different SE disciplines, domains or development circumstances
Maturity and Repeatability Attributes *Evaluation Scale:* *Unknown - Not determinable at this time (score: <null>)* *None - does not currently meet this attribute (score: -1)* *Partial Support – Weakly meets this attribute (score: 0)* *Explicit Support – Strongly meets the attribute] (score: +1)*	
Definition	Is defined sufficiently to be studies/replicated.
Experience	Is implemented or used in multiple instances
Breadth	Has been applied over a range of different types of organizations or application areas (e.g. acquirers, developers, integrators; business, communications, defense, medicine, space, cyber-physical)
Media Presence	Is meaningfully referenced (e.g. reviews, analyses, case studies) directly or in analogy in technical media (e.g. journals, technical reports, respected blogs)

Attribute	Description
Adoptability Attributes *Evaluation Scale:* *Unknown - Not determinable at this time (score: <null>)* *None - does not currently meet this attribute (score: -1)* *Partial Support – Weakly meets this attribute (score: 0)* *Explicit Support – Strongly meets the attribute] (score: +1)*	
Ease of Use	Can be learned and applied by non-experts
Latency	Impacts SE agility within an acceptable time frame
Cost to Deploy	Investment costs (e.g., special equipment, training) to implement the enabler are acceptable
Cost to Use	Execution costs (licenses, additional staff time) for the enabler are acceptable

Table 2: Evaluation Criteria

Criteria	Description
Impact	High impact in at least one agile attribute and some impact in more than one additional area
Relevance	And
Maturity and Repeatablility	Sufficiently well defined that implementation is portable to other projects; Used successfully in at least one SE-like context.
Adoptability	Are sufficiently related to the culture and processes of current systems engineering practice so as not to be rejected by the majority of the workforce; do not require overly burdensome restructuring of organizational governance or statutory changes

Each white paper will provide the following information:

Summary of Evaluation Assessment and Recommendations for the Enabler

Part I: Description of the Enabler

A description of the enabler including any pertinent information as to its source, its use, and its relationship to other enablers or existing processes. This section may be very short or significant depending on the recommendations

Part II: Evaluation Attributes and Assessment

A completed matrix of the attributes and assessed values (as defined in Table 1), including the rationale for each assessment and a general description of how the enabler could be of value in improving the agility/adaptability/responsiveness of systems engineering, and the rationale for the decision

Part III: Recommendation Details

If the recommendation is for further research, then one or two specific studies/experiments/analyses that would lead to the enabler's validation or support its transition should be described. If the recommendation is for expedited transition, a description of why the team believes this is possible, what type of transition materials exist or need to be created, and identification of organizations that would be appropriate as pilots. If the enabler is deemed not suitable, no further information is required.

Part IV: Previous Research

Previous research and experience in the area of interest that supports this possible usefulness.

Part V: References

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[1] Turner, R. “Acquisition Best Practices – A Study of Best Practice Adoption By Defense Acquisition Programs,” CrossTalk: The Journal of Defense Software Engineering, Vol 15 No.5, May, 2002.

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